

GET THE MOST FROM THIS TECHNICAL BULLETIN . . .

- Use it with your employees to help improve housekeeping and maintenance.
- Use it with your cleaning service, pest control service, and mechanical system (heating and cooling) contractor to reduce costs and enhance the dining environment.
- Use it with engineers, architects, designers, and contractors to improve the efficiency and enhance the dining environment in new facilities or renovations.
- Keep a copy of this technical bulletin and use the checklists to make sure consultants and contractors are following directions.
- Call the **//VIRONMENT** HOTLINE at (800)722-9093 to get additional copies of this technical bulletin or to get answers to your questions about improving the quality of the indoor environment.



CHELSEA
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**VENTILATION
FOR A
QUALITY
DINING EXPERIENCE**

**A
TECHNICAL BULLETIN
FOR
RESTAURANT OWNERS
AND MANAGERS**



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Ventilation for a Quality Dining Experience: A Technical Bulletin for Restaurant Owners and Managers is one in the series of *ENVIRONMENT*® indoor environmental publications.

Published by Chelsea Group, Ltd.
One Pierce Place, Suite 245 C
Itasca, Illinois 60143

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Development and publication of this technical bulletin sponsored by The Accommodation Program

Additional copies of this technical bulletin are available without charge by calling the *ENVIRONMENT* HOTLINE at (800)722-9093.

IN A HURRY? READ THIS . . .

Here's what you need to know as a restaurant owner or manager . . .
This technical bulletin is brief, but packed with facts. If you have only a minute to look at it, here's the best way to use it:

- Read the entire first page to learn why ventilation is important.
- Photocopy the "Twelve Steps to Better Operations" checklist on page 16 and give it to your employees and contractors.
- If you're building or renovating, photocopy the "Twelve Checkpoints for Better Construction and Renovation" checklist on page 4 and give it to your engineers, consultants, and contractors.
- Read the section on Laws, Regulations, and Standards on page 3.
- Dial (800)722-9093 to reach the *ENVIRONMENT* HOTLINE with questions about improving indoor environmental quality and for copies of this technical bulletin to hand out to employees, engineers, consultants, and contractors.



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FOR YOU, THE RESTAURANT OWNER OR MANAGER

Restaurateurs provide a combination of food and ambiance that adds up to a special dining experience. Whether the dining experience is meant to provide fast service, a chic setting, or old-fashioned family dining, some fundamentals remain the same: quality food, good service, and comfortable, clean facilities.

The quality of the air provided by the restaurant ventilation system can make a difference in both comfort and the perception of cleanliness for your customers. Good ventilation is neither an afterthought nor an accident. Through proper design and maintenance, the ventilation system for your restaurant can become an important part of your competitive edge.

What happens when ventilation is given a back seat to the more pressing issues of restaurant management? First, your guests are treated to the smell of what's on the grill, or worse, what was on the grill yesterday. Second, every time the door is yanked open against the pull of the exhaust system, outside air rushes in, bringing dust, dirt, insects, and uncomfortable drafts. Third, your crew spends more time cleaning up the greasy film that settles on everything in the restaurant. Fourth and finally, you probably pay substantially more in utility bills than you need to. In short, ignoring the ventilation system costs plenty.

Other issues of serious customer concern relate to good ventilation, as well. During the past two decades, restaurants have moved to provide accommodation for both smokers and non-smokers through installation of smoking sections in many facilities. For you, as a restaurant owner or manager, the real question is not space allocation, but providing a quality dining experience for both smokers and non-smokers.

While restaurant facilities are as diverse as the foods they serve, this technical bulletin distills some of the essential elements that determine the effectiveness of ventilation system design, operation, maintenance, and housekeeping. Use this technical bulletin with your employees, contractors, and consultants to transform your restaurant into a place where customers delight in their dining environment.



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SETTING YOUR OBJECTIVES

Customers set the standards for the quality of their dining experience, and you must respond to their concerns first. In this technical bulletin, we set three objectives:

1. Provide sufficient ventilation for basic indoor air quality, including control of odors, grease, and smoke in dining areas.
2. Provide a comfortable environment for both smokers and non-smokers.
3. Minimize both capital and operating costs for achieving a quality dining environment.

LAWS, REGULATIONS, AND STANDARDS

There are currently no Federal regulations for indoor air quality in restaurants. The only widely accepted national standard addressing this issue is ANSI/ASHRAE Standard 62-1989, *Ventilation for Acceptable Indoor Air Quality*. This ASHRAE Standard establishes minimum outdoor air requirements for ventilation of spaces where food and beverage service is provided. These requirements are stated in cubic feet per minute (cfm) of outdoor air per person occupying the space, which we will call ventilation rates. Occupancy levels stated in the standard correlate these ventilation rates with the maximum occupancy in the net occupiable space. Here are some of the key ventilation rates and occupancy levels that are important in restaurants:

Area	Ventilation Rate	Occupancy Level
Dining rooms	20 cfm/person	70 Persons/1000 sq. ft.
Cafeteria, fast food	20 cfm/person	100 Persons/1000 sq. ft.
Bars, cocktail lounges	30 cfm/person	100 Persons/1000 sq. ft.
Public restrooms	50 cfm/water closet or urinal	
Kitchens (cooking)	15 cfm/person	20 Persons/1000 sq. ft.

These ventilation rates are designed to provide acceptable indoor air quality for areas in which a moderate amount of smoking occurs. For bars and cocktail lounges, where more smoking is likely to take place, the ASHRAE Standard states that supplementary smoke removal may be necessary. These and other design issues are reviewed in ASHRAE's 1991 *HVAC Applications Handbook* (pages 3.4 and following). In addition, you should make sure your consultants and contractors apply all local codes and ordinances.



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TWELVE CHECKPOINTS FOR BETTER CONSTRUCTION AND RENOVATION

Before you begin . . .

- ☒ Define how each area of the restaurant floor plan, or "footprint," will be used, and how use may change over time

During design . . .

- ☒ Review the ventilation zones and air flow patterns of the "pressure footprint" for conformance to planned uses
- ☒ Evaluate ventilation specifications for compliance with ASHRAE Standard 62-1989, related standards, and local codes and regulations
- ☒ Look at the location of outdoor air intakes to make certain they are not near sources of pollution (e.g. loading dock, trash disposal, exhaust vent)
- ☒ Check control sequence for ability to keep planned pressure relationships under various operating conditions
- ☒ Check controls design for simple operation by a non-technical operator

Get ready for construction . . .

- ☒ Select construction materials and furnishings for low toxicity and easy maintenance
- ☒ Select appropriate filters to achieve acceptable indoor air quality for planned uses
- ☒ Evaluate plans for ease of operations, maintenance, and housekeeping

During start-up . . .

- ☒ Inspect construction, checking that it meets design specifications, and bring in a certified test and balance contractor to review air flow patterns
- ☒ Review operation and maintenance manuals for complete and simple instructions, procedures, and equipment information
- ☒ Follow a formal commissioning procedure that tests systems under varying conditions (see ASHRAE Guideline 1-1989, *Commissioning of HVAC Systems*)

DESIGNING A QUALITY DINING ENVIRONMENT

PRINCIPLES

This technical bulletin uses three guiding principles in design of restaurant ventilation systems that have been proven in practical application at thousands of restaurants around the world.

1. Keep dining area air pressure slightly positive to the surrounding environment.
2. Maintain the smoking section of the dining area, as well as kitchen and restroom areas, at an air pressure slightly negative to the surrounding environment.
3. Minimize cross zone air flows.

SYSTEM CONCEPTS

AIR BALANCE

The basic designs presented in this technical bulletin use pressure differences between zones in a restaurant to control comfort and contaminants. This zoning approach requires proper air balancing at commissioning, then routine testing and rebalancing for good maintenance. Successful application of this bulletin requires an understanding of pressure differences and air balancing concepts.

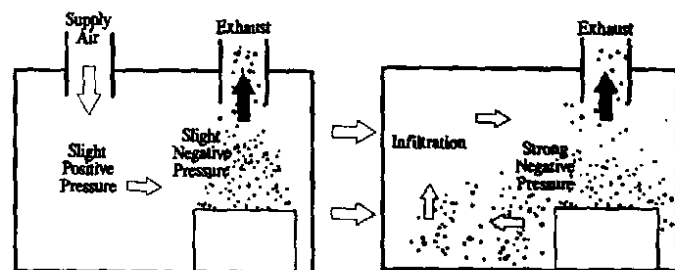
- A positive air pressure zone is created when more air is supplied to an area than is removed from it.
- A negative air pressure zone is created when more air is removed from an area than is supplied to it.
- Air flows from areas of positive pressure into areas of negative pressure. →



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UNDERSTANDING PRESSURE RELATIONSHIPS



Without adequate supply air, the kitchen exhaust fails to remove much of the grease and smoke from cooking. Also, strong negative pressure zones draw unconditioned air which infiltrates through open doors and cracks, bringing in dirt, insects, and drafts.

- Slight pressure differences help, large pressure differences cause problems.
- A zone is positive relative to the outdoor environment when its barometric air pressure is greater than that of the outdoor environment.

CONTROL SYSTEMS

The control systems for restaurants should be as simple to operate as possible, regardless of how complex the actual control sequences may be. Daily operation of the control system will often be done by a non-technical person, most likely someone

involved with the food service aspects of the facility. Control sequences which require complex tasks for the operator represent an invitation to incorrect operation, since what seems logical and obvious to a control designer generally will not seem so to a non-technical person. However complicated the actual control sequence may be, the operator at the restaurant should be able to control the ventilation system on a daily basis with a simple button or on-off switch.

The basic control options for simple control systems are hand switches and timeclocks. Hand switches are the simplest, as long as systems are properly interlocked to protect control sequences. Timeclocks are often frustrating to non-technical equipment operators because they require programming or manipulation when conditions change. Often, timeclocks will be disconnected by operators if the programming proves too complex or time consuming.

Advanced control systems offer many opportunities to increase the efficiency of ventilation systems while enhancing the quality of the dining environment. For restaurants with multiple air handlers, computerized control systems can offer several features to reduce utility costs while enhancing ventilation for a quality dining environment.

- Automatic on-off and temperature control, with self adjusting starting and stopping times based on actual conditions
- Automatic pressurization control to keep the dining area slightly positive compared to outdoor air pressure
- Automatic occupancy tracking, using carbon dioxide (CO_2) as a measure of occupancy and adjusting ventilation rates and zone pressure relationships to match
- Integration of fire alarm and fire suppression with ventilation control, with automatic reporting of information for records and inspections

Advanced controls should be simple to use in daily operation, and capable of operation and minor reprogramming by a non-technical user



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VARIABLE AIR VOLUME SYSTEMS

Investing in variable air volume (VAV) systems offers cost savings by allowing automatic correlation of occupancy levels and ventilation rates. VAV systems work by varying the amount of air that is supplied and exhausted in a specific zone of a restaurant to meet comfort and ventilation requirements as they change with occupancy.

Control of VAV systems using carbon dioxide (CO_2) levels presents a new opportunity to reduce costs by tracking occupancy zone by zone. ASHRAE Standard 62-1989 suggests a guideline of 1000 ppm (parts per million) of CO_2 for minimum acceptable ventilation. Designing a restaurant ventilation system to track occupancy using CO_2 and varying ventilation rates to comply with the ASHRAE Standard 62 guidelines may reduce operating costs where the number of occupants varies widely over each business day, as it does in most restaurants.

Incorporating a VAV system into a restaurant that uses fixed kitchen exhaust requires special design consideration. The minimum amount of outdoor air supplied by the VAV system must be sufficient to compensate for the constant volume of makeup air required by the kitchen exhaust. An interlock between the kitchen exhaust fans and the VAV minimum outdoor air supply can be used to protect the system from excessive exhaust.







Designing and operating VAV systems to track occupancy presents a challenge in maintaining pressure balances between zones within the restaurant. Controlling ventilation rates on CO_2 simplifies calculation of outdoor air supply rates, but complicates temperature control strategies. These essential elements must be designed into the automated control system that manages the VAV system. Like all restaurant control systems, that complexity must be invisible to the operator.

DESIGN OPTIONS

The diverse styles and settings of restaurant facilities make it challenging to generalize about design options. In this technical bulletin, we consider three basic ventilation design options:

1. Single air supply system plus kitchen and restroom exhaust
2. Multiple air supply and exhaust systems
3. Integrated restaurant and cocktail lounge or bar with multiple air supply and exhaust systems

SYMBOLS LIBRARY

		
Supply Fan	Exhaust/ Return Fan	Damper
		
Filter	Heating Coil	Cooling Coil



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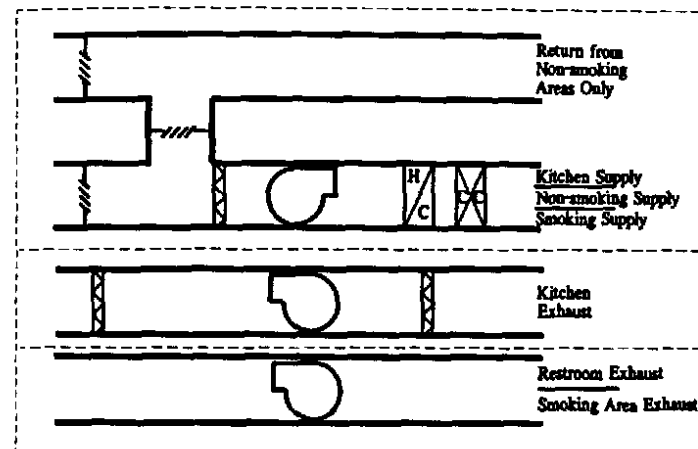
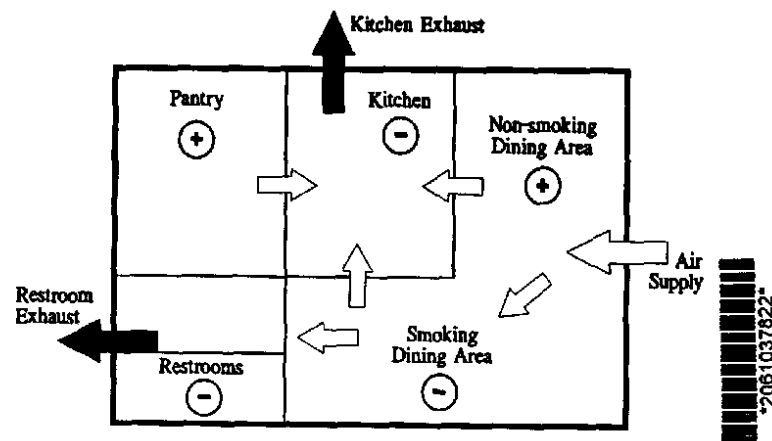
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1. SINGLE AIR SUPPLY PLUS KITCHEN AND RESTROOM EXHAUST

Most smaller restaurants are designed with a single air supply system and a few exhaust fans. Typically, the supply fan will serve the dining area and pantry, and sometimes add makeup air to the kitchen. Exhaust fans are used in the kitchen to eliminate cooking smoke, fumes, and gases and in restrooms to eliminate odors. For purposes of accommodating both smokers and non-smokers in restaurants using this type of ventilation system, design can be simplified by using an existing exhaust point to create the negative pressure area appropriate for a smoking section.

For restaurants of this scale, the outdoor air supply system is sometimes eliminated from designs on the assumption that sufficient negative pressure from kitchen exhaust will draw in outdoor air from passive sources, such as doors and windows. Without adequate supply air, the kitchen exhaust fails to remove much of the grease and smoke from

PRESSURE FOOTPRINT: SINGLE SUPPLY SYSTEM



FAN SYSTEM SCHEMATIC: SINGLE SUPPLY SYSTEM

cooking. Often a heating and cooling unit which recirculates interior air is used to provide comfort in the dining area. This design approach is not a good practice, and results in operational and cleaning problems for restaurants. In addition, such designs do not provide sufficient control of air flows.

Control systems for small scale restaurants generally need to be simple to operate, since no permanent maintenance or mechanical staff is available to oversee daily procedures. An interlock of the kitchen exhaust, restroom exhaust, and the main supply of outdoor air should be sufficient to assure that outdoor air is available when cooking begins. For these simple controls a single on-off switch or timer for the entire system, plus a thermostatic control for interior space temperature, should be sufficient.

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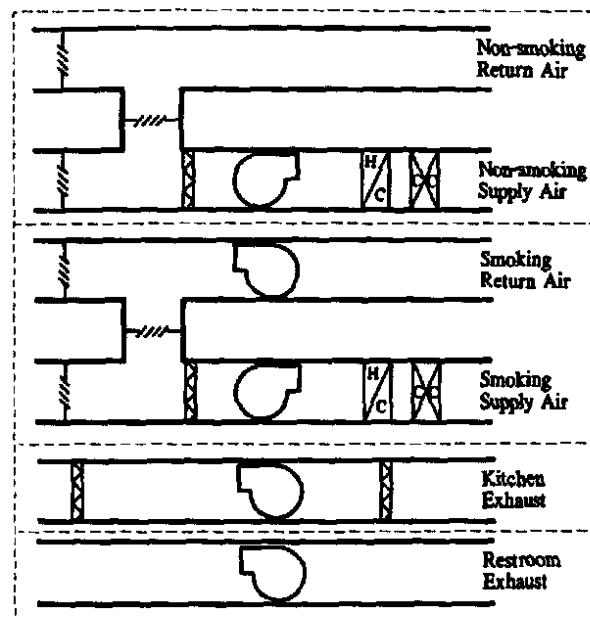
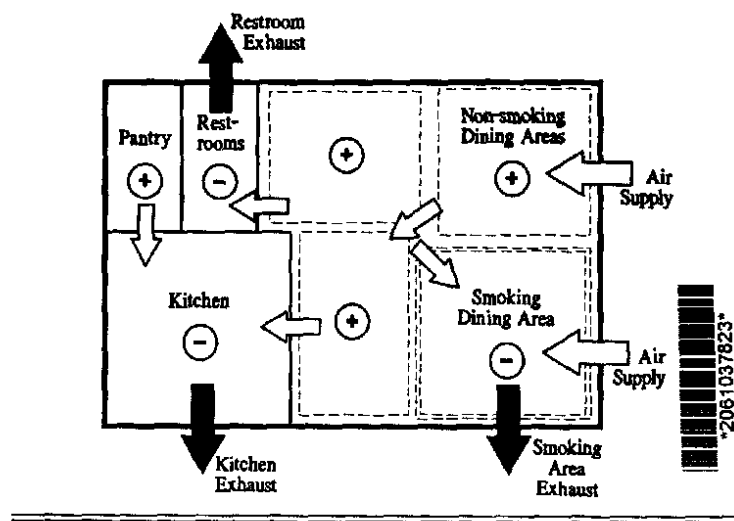


2. MULTIPLE AIR SUPPLY AND EXHAUST SYSTEMS

Restaurants served by more than one air supply system enjoy greater flexibility in design. With the added flexibility comes an increased need to plan space use and probable changes in use over time. The challenge in restaurants with multiple outdoor air supply units and multiple exhausts is keeping the systems in balance relative to each other and matching the real pressure footprint of the restaurant to its design and use.

With a carefully planned footprint, a restaurant design which uses several air handling units can incorporate a smoking zone anywhere within the dining area. Using the guidance of ASHRAE Standard 62-1989, the smoking zone can recirculate a portion of the total air supply, as long as the minimum outdoor air requirements of 20 cfm per occupant can be met. Creating a zone of negative air pressure for the smoking area simply requires exhausting slightly more air than is taken in from the outdoors and supplying a compensating amount from the surrounding non-smoking areas. Local codes and ordinances should be checked for flexibility on this issue.

PRESSURE FOOTPRINT: MULTIPLE AIR HANDLERS



FAN SYSTEM SCHEMATIC: MULTIPLE AIR HANDLERS

Control of multiple supply and exhaust units presents a significant challenge. However, a carefully planned footprint will enhance control simplicity. While the controls should be simple to operate for the restaurant owner or manager, complex control interactions must automatically compensate for different operating conditions during the daily and weekly cycles of a large restaurant. Timed controls can incorporate outdoor air ventilation prior to occupancy to enhance air quality. More elaborate controls, using timers or CO₂ sensors, can be set to increase outdoor air as the number of occupants increases. Control designs should include an electrical interlock to synchronize minimum outdoor air supply and exhaust fan operation.

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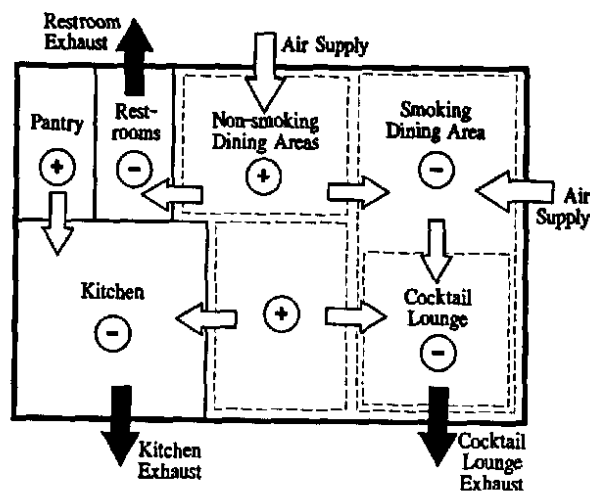


3. INTEGRATED RESTAURANT AND BAR OPTIONS

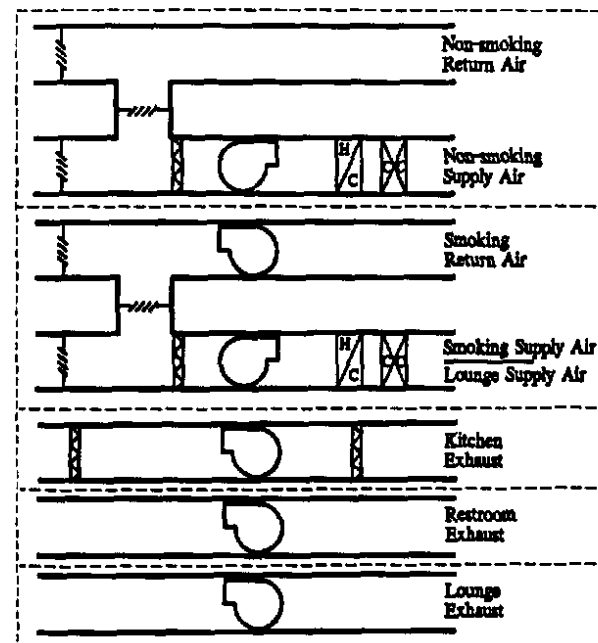
Many restaurants combine cocktail lounges or bars with their eateries. The basic design presented here places the cocktail lounge area within or immediately adjacent to the smoking area of the dining section, which combines two negative pressure zones into one overall dining space. The design assumes that multiple air handlers serve the dining and bar area. One air handling unit can supply the ventilation air for both the smoking area and the cocktail lounge. The cocktail lounge, which is a negative air pressure zone relative to the smoking area, is equipped with a separate exhaust fan to compensate for the higher levels of smoking typical of such spaces.

Control systems for a multiple air handler facility with a cocktail lounge present issues similar to those of any other multi-system restaurant, as outlined in design option two. Additional considerations result from the issue of the timing and extent of occupancy. A manual control system can be designed to accommodate the cocktail lounge exhaust fan by interlocking its operation with the smoking section air supply system. The

PRESSURE FOOTPRINT: EATERY AND BAR



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FAN SYSTEM SCHEMATIC: EATERY AND BAR

outdoor air dampers for the smoking section air handling unit need to open automatically to add an amount of makeup air equivalent to the cocktail lounge exhaust. The control system can be operated either by hand, or using a simple timeclock to match occupancy times.

Since ventilation rates are high for cocktail lounge areas, using a computerized control system to track actual occupancy with ventilation rates presents the possibility of real savings. This can be done using CO₂ sensing devices. Variability of ventilation rates also requires dynamic balancing to maintain relative pressure among non-smoking, smoking, and lounge areas while occupancy and ventilation rates change.

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TWELVE STEPS TO BETTER OPERATIONS

Every day . . .

- ☒ Provide outdoor air ventilation during and after cleaning and pesticide applications
- ☒ Use high efficiency filtered vacuums on all carpets and cloth upholstery
- ☒ Avoid use of "deodorants" and off-the-shelf disinfectants and pesticides
- ☒ Check and clean kitchen exhaust filters and grease traps

Every month . . .

- ☒ Check controls and ventilation equipment for proper operation and compliance with design criteria
- ☒ Check and change air supply filters, clean condensate pans and humidifiers

Four times a year . . .

- ☒ Check and clean the fan unit and air supply and return grills in the restaurant
- ☒ Check damper operation, lubricate and tighten as required

Once a year . . .

- ☒ Review cleaning, maintenance, and pest control products for minimum toxicity
- ☒ Maintain a notebook of Material Safety Data Sheets on all cleaning, maintenance, and pest control products
- ☒ Clean cooling coils and condenser coils in the spring
- ☒ Check and clean heat exchanger and ducts, and check efficiency of furnace section in the fall

IMPROVING MAINTENANCE AND OPERATIONS

A ventilation system designed to provide a quality dining environment requires maintenance to sustain its value and functionality. Maintenance includes keeping controls operating correctly, motors and dampers working efficiently, fans, ducts, and diffusers clean, and system balance according to plan. These maintenance items are interrelated, and failure to perform in one area may lead to failure in others. No matter how perfect the design and initial installation of the equipment, if not properly maintained, the ventilation system will gradually give out, no longer providing the quality dining environment for which it was designed.

MECHANICAL SYSTEMS

Maintaining controls protects air quality and efficiency. The more sophisticated the controls and the ventilation system, the more frequently the system needs to be checked. Specific operations of the controls need to be checked for calibration, as well as operability. Several sensors may be specified in the design, including temperature, humidity, pressure, and carbon dioxide (CO₂). Each sensor should be placed on a preventive maintenance schedule and tested and calibrated to assure proper function. This is particularly important with pressure and CO₂ sensors. These are higher maintenance sensors, and their lack of calibration can result directly in a poor quality dining environment.

Checking air balance keeps the environment working according to plan. It needs to be tested at least once a year. Use a well qualified and experienced test and balance contractor.

Clean, properly maintained equipment runs more efficiently. Keeping dampers and fan blades free of debris through regular cleaning contributes to both efficient operations and improved quality in the dining environment. ➡



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In addition to cleaning, mechanical equipment requires regular maintenance by a qualified mechanic. This maintenance includes lubricating motor and fan bearings, checking and lubricating damper linkages, checking and tensioning fan drive belts, and related inspections. Since the maintenance requires opening up and examining the air handling units, this is also a good time to check filters and control system components.

FILTRATION

Choose the right filters for quality and efficiency. The basic filters used in most restaurant outdoor air supply systems are rated at 25% efficiency, which is sufficient to keep the air handler clean. Increasing levels of filtration by using higher efficiency filter media or adding electronic or chemical cleaning devices offers another opportunity to improve the indoor environment. In many instances replacing 25% efficient filters with 65% to 95% efficient filters may be sufficient. Under more extreme conditions, an activated carbon filter could prove valuable in reducing residual cooking odors. Similar consideration can be given to areas of the restaurant where high levels of smoking occur, such as cocktail lounges and bars.

Regardless of the filtration strategy you select for the restaurant, establish a routine filter change program to protect equipment and the dining environment. If inspection shows unusual buildup of oils or dirt, or reveals punctures or tears in the filter medium, the filter should be replaced immediately. If left unchanged, the filter medium may begin to contribute odors from the stale oils and particulates. Frequent filter changes represent an inexpensive way to maintain a quality dining environment.

Kitchen exhaust filtration may be a requirement of local codes. The first element of filtration of kitchen exhaust is grease removal. Primary grease filters that are removed and washed daily provide a first defense. Controlling grease and keeping it from collecting anywhere in or around the restaurant is a key part of keeping down odors and biological problems that can have a negative impact on the dining environment.

INTERIOR HOUSEKEEPING PRACTICES

Many products intended to improve the dining environment actually serve to make it less pleasant for customers. For example, cleaning fluids that use a strong odor to mask other smells — to "deodorize" the area — use chemical compounds that are common irritants to many people. Don't try to mask problems with deodorants. To mask an odor with another odor complicates the primary problem and makes solving it more difficult. The best solution is keeping things clean.

Selection of housekeeping products represents an opportunity to benefit your employees, your customers, and your bottom line at the same time. Take the time to review all cleaning and pest control products for their toxicity, which can be done by asking vendors for copies of Material Safety Data Sheets that spell out chemical contents and health effects. Then select the smallest possible number of products with the least potential for health effects to serve your needs. Test products for their ability to perform the housekeeping tasks you want to accomplish, and for the odors they leave after use. Selecting products with low known toxicities will reduce the potential for ill effects among your employees; reducing odors will improve your customers' perception of the indoor environment; and limiting the number of products you buy can reduce your net cost.

Ventilate with outdoor air during and after cleaning to minimize odors. Often housekeeping is done after hours, when ventilation systems are normally shut off. Leaving the ventilation system on during and for a while after housekeeping is done gives the restaurant a chance to air out. The net result is a healthier environment for the cleaning crew, and a better smelling restaurant for your guests.

BETTER PLANNING AND MAINTENANCE PAY BACK

Taking more care in the design, operation, and maintenance of ventilation systems can make a bottom line difference in restaurants. Better operations mean a better quality dining environment. That translates into more return customers and better business from an improved dining experience.



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Standard 62-1989 Ventilation for Acceptable Indoor Air Quality

Available from the Environmental Protection Agency (EPA) and the National Environmental Health Association (303) 756-9090

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